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Forest Insect & Disease Management
Pacific Northwest Region

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Forest Pest Survey, Deming Timber Sale
Bly District, Fremont National Forest

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Appreciation is extended to Alan Kanaskie and Tom Gregg for assisting in this evaluation.

INTRODUCTION

During the week of June 1, 1981, an insect and disease survey was done by a Forest Pest Management pathology crew on the Deming Timber Sale, Bly Ranger District, Fremont National Forest. The unit surveyed was in T. 36 S., R. 15 E., sec 14, 15, and 16 (Figure 1). District personnel previously had found annosus root rot (caused by the fungus *Fomes annosus*), causing what appeared to be substantial damage in the area. They requested an evaluation to determine distribution and intensity of annosus root rot and other diseases and insects in the timber sale and to provide recommendations for pest management on the unit.

METHODS

Approximately 1,000 acres were surveyed systematically, using a variable plot method. A Spiegal-Relaskop was employed to define each plot, and a basal area factor of 40 was used as a standard. Plots were located at two chain intervals along lines 15 chains apart across the unit. All trees within each plot were examined and the following information was recorded: tree species, DBH, general condition (live, dead, standing, or down) and presence of disease or insect infestation. Two roots on opposite sides of each dead or symptomatic tree were excavated to a distance of 3 feet from the root collar and examined for evidence of root disease. Samples of stained or decayed wood from roots of recently dead or live symptomatic trees were returned to the laboratory for culturing. Roots and butts of old dead trees were dissected to determine the character of wood decay. Also, trunks were examined for signs and symptoms of heartrot, including conks and large wounds, bark was removed from stems of bark beetle-infested trees to expose galleries for beetle species determination, and crowns of all trees were examined for signs and symptoms of such diseases as dwarf mistletoes and rusts. From the data collected in plots, the Region 6 V-plot computer program was used to calculate mean basal area, number of trees and volume per acre by tree species, DBH class, and disease condition or insect infestation category.

In addition to the basal area plot, a .01-acre fixed-area plot was established at each plot center to assess disease occurrence and severity in trees too small to be included in the Relaskop sample. In these plots, all trees greater than 6 inches tall but less than 3 inches DBH were examined in the same manner as were the variable plot trees.

Fomes annosus often does not cause foliage symptoms in true firs until colonization is quite advanced. Since only symptomatic or dead trees were sampled in our survey, it was necessary to get some idea of amount of hidden infection. To do this, one discrete annosus center was investigated in detail by running sample lines from the infected stump in the middle out into the surrounding forest to a distance of 60 feet. All trees along lines were scrutinized for symptoms of crown decline and then all, regardless of crown condition, were felled. A slab was removed from the stump just above ground level and samples were taken from each of two roots excavated to a distance of 3 feet from the root collar. All samples were incubated in the laboratory, and occurrence of *F. annosus* infection was determined based on formation of imperfect fruiting bodies (*Oediocephalum*).

RESULTS AND DISCUSSION

The Deming Sale area can be divided into three general stand types (figure 2). The northeastern corner (Type A) is dominated by white fir (*Abies concolor*) with a fairly substantial old-growth ponderosa pine (*Pinus ponderosa*) component. Lodgepole pine (*P. contorta*) and western white pine (*P. monticola*) are scattered through the stand. In the northwestern corner (Type B), ponderosa pine is the main species with a lesser component of white fir and also some lodgepole pine, western white pine, and incense cedar (*Libocedrus decurrens*). The southern part of the stand (Type C) occurs on a generally steep, exposed south-facing slope and is dominated by ponderosa pine and incense cedar. White fir occurs in stringers along creeks and draws.

The entire sale area was harvested selectively in the early 1950's, and the forest is multi-storied and uneven-aged in all of the stand types. Mean basal areas, numbers of trees, and volumes per acre by tree species and DBH are summarized for the sale area in tables 1, 2, and 3.

Several kinds of diseases and insects were encountered in the survey. Major differences in pest occurrence were evident between the stand type predominated by white fir (type A) and those predominated by ponderosa pine (types B and C). Mean basal area, number of trees, and volume per acre affected by each disease or insect are summarized for stand type A in tables 4-6 and for stand types B and C in 7-9. Pest distributions are shown in figures 3-15. The following is a detailed examination of each disease or insect:

Diseases

Annosus Root Rot - *Fomes annosus*, cause of annosus root rot, is spread by windborne spores. Fruiting bodies, usually found in hollow stumps (figure 16), produce large numbers of spores that can be blown long distances. If spores land on freshly cut stump surfaces or recently created wounds, they germinate, and the fungus colonizes the stump or tree. It then grows through the root system and hence across grafts and contacts into the roots of nearby healthy trees. Infection results in tree decline and, eventually, death (figure 17). Rate of killing depends on host species and fungus strain. Infection centers (figure 18) develop as the disease progressively spreads across tree roots into the surrounding stand, usually at a rate of about 1 foot per year.

As was expected, annosus root rot was common and damaging in portions of the Deming Sale area. White fir was the only tree species affected and trees of all sizes and age classes were found to be diseased. The disease was distributed wherever white fir occurred (figures 3, 4, 5), but was mainly concentrated in stand type A. In this type, 21.5 percent of the white firs containing 35.4 percent of the white fir volume (19.2 percent of all trees containing 29.9 percent of all volume in the stand type) had detectable infections. Ninety-one percent of the detectably infected trees already were dead.

Results of our in-depth analysis of one discrete infection center suggests that there are probably many more infected trees than could be detected by checking dead and symptomatic trees only (table 10). In fact, it appears that non-symptomatic trees within 36 feet of a 28-inch diameter infected stump cut 25 to 30 years ago have a high probability of being infected, and there is even some chance that trees as far as 50 feet from such a stump may be diseased (figure 19). All told, 38 percent of the infected trees within 60 feet of the infected stump in the disease center examined showed no symptoms.

There are a mean of 10.1 white fir stumps per acre in stand type A. Average diameter is 30 inches and 92 percent are infected by *F. annosus*. With so many points of initial infection, disease centers overlap throughout much of the stand. Annosus root rot is by far the most important disease in type A and should be of major concern to forest managers.

Armillaria Root Rot - *Armillaria mellea*, cause of Armillaria root rot, survives as a saprophyte in old stumps and roots and can infect nearby trees across root contacts or by growing short distances through the soil. Usually, *A. mellea* is a weak pathogen that infects and helps to kill stressed or injured trees. Most dying trees with Armillaria root rot are overmature, unthrifty, or are suffering from the effects of some other disease.

Armillaria root rot was found affecting some white fir in stand type A of the Deming Sale. The disease was not detected on other hosts or in other parts of the Sale. Distribution was as shown in figure 6. *Armillaria mellea* was found infecting mainly medium to large-size trees and was detected most commonly on trees also infected by *F. annosus*. However, in stand type A, it was found by itself on 0.9 percent of the white firs containing 3.03 percent of the volume.

Indian Paint Fungus - White firs, as non-resinous, relatively thin-barked conifer species, are highly susceptible to infection by heart rot organisms. They are very likely to develop decay when they reach fairly advanced ages (in excess of 120 years). The Indian paint fungus, *Echinodontium tinctorium*, one of the most common heart rot fungi of white fir in southern Oregon, enters its host through small dead branchlets and is later activated by wounding to cause large decay columns. Damage potential can be particularly high in non-vigorous, suppressed, understory trees that are wounded during an overstory removal.

Fruiting bodies of Indian paint fungus were observed on trees scattered throughout white fir stands on the Deming Sale. Distribution was as shown in figures 7 and 8. Most were found in stand type A where 6.6 percent of the trees containing 9.3 percent of the white fir volume exhibited conks.

Occurrence of one or more Indian paint fungus conks on a tree usually indicates considerable cull. Cull estimates for Indian paint fungus are summarized in "Defect estimation for white fir in the Fremont National Forest" by Paul E. Aho and Philip Simonski (USDA For. Serv. Res. Pap. PNW-196, 9 p. 1975).

Dwarf Mistletoes - The dwarf mistletoes are parasitic higher plants that obtain food and water from their hosts. They can cause a sufficient drain on the host in some cases to result in serious tree debilitation, but effects differ with degree and location of infection, host and mistletoe species, and host vigor. Dwarf mistletoe spread is by forcibly discharged seeds that are shot out from the mature female plant in the host tree into the crowns of other trees below. Most of the dwarf mistletoes are quite host specific and will successfully infect only one tree species.

White fir dwarf mistletoe, *Arceuthobium abietinum* f. sp. *concoloris*, normally has little effect on young vigorous firs unless infection is extremely severe. In older, unthrifty trees, however, mistletoe infections, especially if in the upper crown, can cause significant decline and may contribute to tree death. In the Deming Sale area, white fir dwarf mistletoe seems to be a minor disease relative to root diseases. Still, our survey revealed that 6.6 percent of the white firs in stand type A are infected. A few trees had canker fungi (probably *Cytospora* sp.) invading dwarf mistletoe infections and causing spectacular branch flagging. Distribution of white fir dwarf mistletoe is shown in figure 9.

Ponderosa pine dwarf mistletoe, *A. campylopodum*, (figure 20) is more damaging than white fir dwarf mistletoe. In fact, in stand type C, ponderosa pine dwarf mistletoe is undoubtedly the most damaging pathogen. While infections in the lower crown can be relatively inocuous, those in the tops of ponderosa pines can result in stunting, malformation, and sometimes death. Effects can be particularly devastating in heavily stocked patches of young trees growing directly beneath a large, heavily-infected residual. In such cases, a stand of small, deformed, severely diseased trees may occupy the site indefinitely with no chance of ever developing into worthwhile size (figure 21). Our survey showed that 42 percent of the ponderosa pines in stand type C are infected by dwarf mistletoe. Infection is greatest in the smaller size classes. Figure 10 shows distribution of the disease. Most severe infection with the greatest potential for future losses occurs in the young understory in the southern part of stand type C. Intensity of disease varies considerably, with patches of heavily diseased, lightly diseased and apparently uninfected trees separated by only a few yards. Ponderosa pine dwarf mistletoe is another disease that should be of major concern to the manager.

Elytroderma Needle Disease - Elytroderma needle disease, caused by the fungus *Elytroderma deformans*, is distinguished by being the only systemic needle cast disease of ponderosa pine in southern Oregon. The disease causes formation of perennial witches'-brooms that may cause some growth loss and rarely result in top deformation.

Elytroderma needle disease had a sparse distribution in the Deming Sale. Only 0.1 percent of the ponderosa pines in stand types B and C were infected.

Insects

Fir Engraver Beetles - The fir engraver, *Scolytus ventralis*, is the major bark beetle pest of white fir. Trees of any size may be infested, but the beetles are most successful on trees that have been weakened by some other factor. Especially subject to infestation are injured, drought weakened, or root diseased trees.

Fir engravers had infested a substantial number of white firs in the Deming Sale area, especially in stand type A. Distribution of infested trees was as shown in figures 11 and 12. In type A, 15.6 percent of the white fir containing 16.6 percent of the volume of that species had been infested. Virtually all infested trees were also infected by *F. annosus*. For the most part, the role of the beetles was secondary.

Pine bark beetles - The mountain pine beetle, *Dendroctonus ponderosae*, is the major bark beetle pest of ponderosa, lodgepole, and western white pine in the western United States. When populations are at endemic levels, the beetle tends to infest and kill weakened or overmature trees or trees in overstocked stands, but when epidemics develop, it exhibits no such selection, killing trees regardless of condition. The western pine beetle, *D. brevicomis*, also attacks pines. It is normally less aggressive than the mountain pine beetle, but infests overmature ponderosa pine fairly commonly.

Pine bark beetles had infested ponderosa pine in several portions of the Deming unit. No infestation of lodgepole or western white pine was observed. Distribution of infestation is shown in figures 13, 14, and 15. Bark beetles had infested 13 percent of the ponderosa pine trees containing 4.3 percent of the volume in stand types B and C. Most damage has been caused by mountain pine beetles in overstocked young stands in the south-central part of stand type C. Mountain pine beetles should be of concern to managers in this part of the stand.

MANAGEMENT RECOMMENDATIONS

From the pest management point of view, there are two major problems in the Deming Sale: the first of these is the annosus root rot situation in stand type A, and the second is the dwarf mistletoe-mountain pine beetle situation in the southern part of stand type C. Stand type B and the northern portion of type C have relatively few, scattered disease or insect occurrences and do not really need special treatment.

Recommendations for Stand Type A - Due to the extremely severe annosus root rot and associated Armillaria root rot and fir engraver beetle activity in white fir, we strongly recommend special treatment for this entire stand type. We believe that a normal selective harvest with retention of white fir in this stand would only exacerbate the pest problems resulting in an even greater loss of site productivity. Basically, we suggest that white fir be discouraged on this site and be replaced by other well-adapted tree species. Studies and observations indicate that the white fir strain of *Fomes annosus* will not infect ponderosa, lodgepole, or western white pine, so we suggest favoring any or all of these species. Pines of these three species occur naturally in the unit and probably made up a major part of the stand prior to fire exclusion and the past selective harvests. The following harvesting and regeneration method options are now suggested:

(1) Clearcut the entire unit and replant with pines.

(2) Patch clearcut the white fir, leaving boundaries containing mostly pine. Replant the patch cuts with pine.

(3) Do a heavy seed tree cut, leaving only pines for seed trees.

If either option (1) or (2) above is used, be sure to employ vigorous, local seed source planting stock. Following establishment of the new stand, discriminate against naturally regenerated white fir in subsequent management entries (precommercial and commercial thinning, future selection cuts, etc.). Stump treatment for annosus root rot control is not recommended.

Recommendations for the Southern Portion of Stand Type C - Pest management activities in this unit should be aimed at (a) minimizing ponderosa pine dwarf mistletoe spread and damage and (b) bark beetle-proofing young ponderosa pine stands through stocking control. During the upcoming timber harvest, we recommend removing as many of the dwarf mistletoe-infected, overstory ponderosa pines as possible. If it can be done, it would also be extremely worthwhile to destroy some of the most heavily infected patches of understory trees. FPM pathologists could aid the District in identifying stands that should be destroyed. After harvest, the remaining ponderosa pine understories should be thinned to a maximum basal area of 120 ft^2. In thinning the stands, favor by order of priority: (1) dominant and codominant incense cedars and ponderosa pines with no apparent mistletoe infections, (2) dominant and codominant ponderosa pines with mistletoe infections limited to the lower third of the crown, (3) dominant and codominant ponderosa pines with less than half of the branches in the bottom half of the crown infected by mistletoe, (4) intermediate incense cedars, and (5) intermediate ponderosa pines with no apparent mistletoe infections. Ponderosa pines with heavy dwarf mistletoe infections in the upper third of the crown should never be retained.

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Table 1: Mean per acre basal area (ft^2) by species and diameter class, Deming Timber Sale

Diameter Class	White Fir	Ponderosa Pine	Lodgepole Pine	White Pine	Incense Cedar	All Species
2	0	.3	.3	0	0	.6
4	3.9	5.4	0	0	3.7	13.0
6	3.9	10.2	0	0	.9	15.0
8	4.2	7.8	0	0	3.0	15.0
10	5.3	5.7	0	0	.3	11.3
12	5.4	3.3	.3	0	.6	9.6
14	5.9	2.3	.4	0	1.5	10.1
16	5.4	1.3	.8	0	0	7.5
18	5.8	2.5	0	0	0	8.3
20	4.4	1.8	0	0	.6	6.8
22	3.9	2.8	0	0	0	6.7
24	2.4	3.1	0	.1	0	5.6
26	4.1	2.5	0	0	.3	6.9
28	3.2	4.9	0	0	.4	8.5
30	1.5	2.2	0	0	0	3.7
32	1.2	4.0	0	0	.6	5.8
34	.7	1.7	0	0	.3	2.7
36	.8	2.0	0	0	0	2.8
38	.9	.3	0	0	.6	1.8
40	.7	1.7	0	0	.9	3.3
42	.8	.7	0	0	.6	2.1
44	.2	.4	0	0	.6	1.2
46	0	.1	0	0	0	.1
48	.1	.3	0	0	.3	.7
50	0	0	0	0	0	0
52	.3	0	0	0	0	.3
54	0	0	0	0	0	0
Total	65.0	67.3	1.8	.1	15.2	149.4

Table 2: Mean number of trees per acre by species and diameter class, Deming Timber Sale

Diameter Class	White Fir	Ponderosa Pine	Lodgepole Pine	White Pine	Incense Cedar	All Species
2	0	13.8	13.8	0	0	27.6
4	44.7	62.0	0	0	41.9	148.6
6	19.7	50.7	0	0	4.6	75.0
8	12.1	22.3	0	0	8.7	43.1
10	9.6	10.4	0	0	.5	20.5
12	6.9	4.2	.4	0	.7	12.2
14	5.6	2.2	.4	0	1.4	9.6
16	3.9	.9	.4	0	0	5.2
18	3.3	1.4	0	0	0	4.7
20	2.0	.8	0	0	.3	3.1
22	1.5	1.0	0	0	0	2.5
24	.8	1.0	0	0	0	1.8
26	1.1	.6	0	0	.1	1.8
28	.7	1.1	0	0	.1	1.9
30	.3	.4	0	0	0	.7
32	.2	.7	0	0	.1	1.0
34	.1	.3	0	0	.1	.5
36	.1	.3	0	0	0	.4
38	.1	0	0	0	.1	.2
40	0	.2	0	0	.1	.3
42	.1	.1	0	0	.1	.3
44	0	0	0	0	.1	.1
46	0	0	0	0	0	0
48	0	0	0	0	0	0
50	0	0	0	0	0	0
52	0	0	0	0	0	0
54	0	0	0	0	0	0
Total	112.8	174.4	15.0	0	58.9	361.1

Table 3: Mean bd. ft. volume (M) per acre by species and diameter class, Deming Timber Sale

Diameter Class	White Fir	Ponderosa Pine	Lodgepole Pine	White Pine	Incense Cedar	All Species
2	0	0	0	0	0	0
4	0	0	0	0	0	0
6	0	0	0	0	0	0
8	0	0	0	0	0	0
10	.1555	.0958	0	0	0	.2513
12	.4375	.2133	.0237	0	0	.6745
14	.5506	.1848	.0307	0	.0859	.8520
16	.6189	.1348	.0627	0	0	.8164
18	.7231	.2977	0	0	0	1.0208
20	.6030	.2362	0	0	.0471	.8863
22	.5753	.3765	0	0	0	.9518
24	.3721	.4541	0	.0088	0	.8350
26	.6669	.3846	0	0	.0308	1.0823
28	.5384	.8236	0	0	.0422	1.4042
30	.2565	.3736	0	0	0	.6301
32	.2107	.7157	0	0	.0749	1.0013
34	.1299	.3029	0	0	.0384	.4712
36	.1552	.3858	0	0	0	.5410
38	.1810	.0595	0	0	.0833	.3238
40	.1452	.3535	0	0	.1229	.6216
42	.1571	.1298	0	0	.0847	.3716
44	.0396	.0900	0	0	.0841	.2137
46	0	.0128	0	0	0	.0128
48	.0268	.0650	0	0	.0456	.1374
50	0	0	0	0	0	0
52	.0661	0	0	0	0	.0661
54	0	0	0	0	0	0
Total	6.6094	5.690	.1171	.0088	.7399	13.1652

Table 4: Mean basal area per acre (ft^2) affected by pests in stand type A

Diameter Class	White Fir						Ponderosa Pine		
	F. annosus	*A. mellea*	F.a. and A.m.	Indian Paint Fungus	Dwarf Mistletoe	Scolytus	Dwarf Mistletoe	Mountain Pine Beetle	Western Pine Beetle
2	.0	.0	.0	.0	.0	.0	.0	.0	.0
4	.6	.0	.0	.0	7.1	.0	.0	.0	.0
6	.0	.0	.0	.0	.0	.0	.0	.0	.0
8	.6	.0	.6	.0	1.8	1.8	.0	.0	.0
10	1.2	.0	.6	.0	.0	2.3	.0	.0	.0
12	.6	.0	.0	.0	1.6	.8	.0	.0	.0
14	5.6	.0	2.1	.4	1.8	4.1	.0	.0	.0
16	5.6	.0	1.9	.0	.9	2.2	.0	.0	.0
18	6.6	1.4	.6	.4	.7	2.1	.0	.0	.0
20	3.1	.6	1.9	.3	.6	.6	.0	.0	.0
22	.6	.6	1.2	.0	.2	.7	.0	.0	.0
24	2.5	.0	.6	.0	.4	.2	.0	.0	.0
26	2.5	.6	.0	.3	.2	.8	.0	.0	.0
28	.6	.0	.0	.1	.3	.0	.0	.0	.0
30	3.1	.0	.6	.3	.0	.4	.0	.0	.0
32	2.5	.6	.0	.1	.0	.1	.0	.0	.0
34	1.2	.0	.0	.0	.0	.2	.0	.0	.6
36	3.1	.0	1.2	.4	.0	.2	.0	.0	.0
38	1.9	.0	.0	.2	.0	.1	.0	.0	.0
40	2.5	.0	.0	.1	.0	.1	.0	.0	.0
42	.6	.6	.0	.1	.0	.1	.0	.0	.0
44	.6	.0	.6	.1	.0	.0	.0	.0	.0
46	.0	.0	.0	.0	.0	.0	.0	.0	.0
48	.0	.0	.6	.0	.0	.0	.0	.0	.0
50	.0	.0	.0	.0	.0	.0	.0	.0	.0
Total	45.6	4.4	12.5	2.8	15.6	16.8	.0	.0	.6

Table 5: Mean number of trees per acre affected by pests in stand type A

Diameter Class	White Fir						Ponderosa Pine		
	F. annosus	*A. mellea*	F. a and A.m.	Indian Paint Fungus	Dwarf Mistletoe	Scolytus	Dwarf Mistletoe	Mountain Pine Beetle	Western Pine Beetle
2	.0	.0	.0	.0	.0	.0	.0	.0	.0
4	7.3	.0	.0	.0	.6	.0	.0	.0	.0
6	.0	.0	.0	.0	.0	.0	.0	.0	.0
8	1.8	.0	1.7	.0	.6	.6	.0	.0	.0
10	2.3	.0	1.1	.0	.0	1.2	.0	.0	.0
12	.8	.0	.0	.0	1.2	.6	.0	.0	.0
14	5.3	.0	1.8	.6	2.3	4.8	.0	.0	.0
16	4.0	.0	1.3	.0	1.2	3.1	.0	.0	.0
18	3.5	.7	.4	.6	1.2	3.7	.0	.0	.0
20	1.4	.3	.9	.6	1.2	1.2	.0	.0	.0
22	.2	.2	.5	.0	.6	1.9	.0	.0	.0
24	.8	.0	.2	.0	1.2	.6	.0	.0	.0
26	.7	.2	.0	1.2	.6	3.1	.0	.0	.0
28	.1	.0	.0	.6	1.2	.0	.0	.0	.0
30	.6	.0	.1	1.2	.0	1.9	.0	.0	.0
32	.4	.1	.0	.6	.0	.6	.0	.0	.0
34	.2	.0	.0	.0	.0	1.2	.0	.0	.1
36	.4	.0	.2	2.9	.0	1.2	.0	.0	.0
38	.2	.0	.0	1.2	.0	.6	.0	.0	.0
40	.3	.0	.0	.6	.0	1.2	.0	.0	.0
42	.1	.1	.0	.6	.0	.6	.0	.0	.0
44	.1	.0	.1	.6	.0	.0	.0	.0	.0
46	.0	.0	.0	.0	.0	.0	.0	.0	.0
48	.0	.0	.0	.6	.0	.0	.0	.0	.0
50	.0	.0	.0	.0	.0	.0	.0	.0	.0
Total	30.5	1.6	8.3	11.9	11.9	28.1	.0	.0	.1

Table 6: Mean volume per acre (M bd. ft.) affected by pests in stand type A

Diameter Class	White Fir						Ponderosa Pine		
	F. annosus	*A. mellea*	F.a. and A.m.	Indian Paint Fungus	Dwarf Mistletoe	Scolytus	Dwarf Mistletoe	Mountain Pine Beetle	Western Pine Beetle
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
8	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
10	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12	.0508	.0000	.0000	.0000	.0793	.0508	.0000	.0000	.0000
14	.5046	.0000	.1660	.0476	.1572	.3946	.0000	.0000	.0000
16	.6236	.0000	.2009	.0000	.1397	.3386	.0000	.0000	.0000
18	.7664	.1495	.0785	.0670	.1483	.4579	.0000	.0000	.0000
20	.4155	.0943	.2449	.0857	.1758	.1714	.0000	.0000	.0000
22	.0992	.0992	.1795	.0000	.0892	.2787	.0000	.0000	.0000
24	.3711	.0000	.0878	.0000	.1920	.0978	.0000	.0000	.0000
26	.4062	.1002	.0000	.1979	.1120	.5065	.0000	.0000	.0000
28	.1065	.0000	.0000	.1065	.2154	.0000	.0000	.0000	.0000
30	.5618	.0000	.1115	.2218	.0000	.3325	.0000	.0000	.0000
32	.4606	.1123	.0000	.1130	.0000	.1215	.0000	.0000	.0000
34	.2281	.0000	.0000	.0000	.0000	.2281	.0000	.0000	.1103
36	.5977	.0000	.2271	.4770	.0000	.2378	.0000	.0000	.0000
38	.3737	.0000	.0000	.2415	.0000	.1255	.0000	.0000	.0000
40	.5047	.0000	.0000	.1262	.0000	.2523	.0000	.0000	.0000
42	.1281	.1206	.0000	.1206	.0000	.1281	.0000	.0000	.0000
44	.1332	.0000	.1300	.1332	.0000	.0000	.0000	.0000	.0000
46	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
48	.0000	.0000	.1338	.1338	.0000	.0000	.0000	.0000	.0000
50	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
Total	6.3318	.6761	1.5600	2.0718	1.3089	3.7221	.0000	.0000	.1103

Table 7: Mean basal area per acre (ft^2) affected by pests in stand types B and C

Diameter Class	White Fir				Ponderosa Pine			
	F. annosus	Indian Paint Fungus	Dwarf Mistletoe	Scolytus	Dwarf Mistletoe	Elytroderma	Mountain Pine Beetle	Western Pine Beetle
2	.0	.0	.0	.0	.0	.0	.0	.0
4	.0	.0	.0	.0	.7	.0	.0	.0
6	.0	.0	.0	.0	2.1	.0	1.4	.0
8	.1	.0	.0	.0	1.7	.0	.3	.0
10	.0	.0	.0	.0	1.7	.0	.0	.4
12	.3	.0	.0	.0	1.3	.0	.3	.0
14	.0	.0	.0	.0	.3	.0	.0	.0
16	.0	.0	.4	.0	.3	.0	.0	.0
18	.0	.0	.0	.0	.7	.0	1.0	.0
20	.0	.0	.3	.3	.3	.0	.0	.0
22	.0	.0	.3	.0	1.3	.0	.0	.0
24	.0	.0	.0	.0	1.3	.0	.0	.0
26	.0	.0	.0	.0	.3	.0	.0	.0
28	.0	.0	.0	.0	1.7	.0	.0	.3
30	.0	.0	.0	.0	.3	.0	.0	.0
32	.0	.0	.0	.0	.7	.0	.3	.0
34	.0	.0	.0	.0	.0	.3	.0	.0
36	.0	.0	.0	.0	.3	.0	.0	.0
38	.0	.3	.0	.0	.0	.0	.0	.0
40	.0	.0	.0	.0	.0	.0	.0	.0
Total	.4	.3	1.0	.3	15.0	.3	3.3	.7

Table 8: Mean number of trees per acre affected by pests in stand types B and C

Diameter Class	White Fir				Ponderosa Pine			
	F. annosus	Indian Paint Fungus	Dwarf Mistletoe	Scolytus	Dwarf Mistletoe	Elytroderma	Mountain Pine Beetle	Western Pine Beetle
2	.0	.0	.0	.0	.0	.0	.0	.0
4	.0	.0	.0	.0	7.6	.0	.0	.0
6	.0	.0	.0	.0	10.1	.0	6.7	.0
8	.3	.0	.0	.0	4.8	.0	1.0	.0
10	.0	.0	.0	.0	3.1	.0	.0	.6
12	.4	.0	.0	.0	1.7	.0	.4	.0
14	.0	.0	.0	.0	.3	.0	.0	.0
16	.0	.0	.3	.0	.2	.0	.0	.0
18	.0	.0	.0	.0	.4	.0	.6	.0
20	.0	.0	.2	.2	.2	.0	.0	.0
22	.0	.0	.1	.0	.5	.0	.0	.0
24	.0	.0	.0	.0	.4	.0	.0	.0
26	.0	.0	.0	.0	.1	.0	.0	.0
28	.0	.0	.0	.0	.4	.0	.0	.1
30	.0	.0	.0	.0	.1	.0	.0	.0
32	.0	.0	.0	.0	.1	.0	.1	.0
34	.0	.0	.0	.0	.0	.1	.0	.0
36	.0	.0	.0	.0	.0	.0	.0	.0
38	.0	.0	.0	.0	.0	.0	.0	.0
40	.0	.0	.0	.0	.0	.0	.0	.0
Total	.7	.0	.6	.2	30.0	.1	8.8	.7

Table 9: Mean volume per acre (M bd.ft.) affected by pests in stand types B and C

Diameter Class	White Fir				Ponderosa Pine			
	F. annosus	Indian Paint Fungus	Dwarf Mistletoe	Scolytus	Dwarf Mistletoe	Elytroderma	Mountain Pine Beetle	Western Pine Beetle
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
8	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
10	.0000	.0000	.0000	.0000	.0438	.0000	.0000	.0000
12	.0175	.0000	.0000	.0000	.0963	.0000	.0197	.0000
14	.0000	.0000	.0000	.0000	.0231	.0000	.0000	.0000
16	.0000	.0000	.0089	.0000	.0395	.0000	.0000	.0000
18	.0000	.0000	.0000	.0000	.0746	.0000	.1168	.0000
20	.0000	.0000	.0082	.0393	.0456	.0000	.0000	.0000
22	.0000	.0000	.0100	.0000	.1844	.0000	.0000	.0000
24	.0000	.0000	.0000	.0000	.2067	.0000	.0000	.0000
26	.0000	.0000	.0000	.0000	.0505	.0000	.0000	.0000
28	.0000	.0000	.0000	.0000	.2770	.0000	.0000	.0584
30	.0000	.0000	.0000	.0000	.0559	.0000	.0000	.0000
32	.0000	.0000	.0000	.0000	.1140	.0000	.0574	.0000
34	.0000	.0000	.0000	.0000	.0000	.0655	.0000	.0000
36	.0000	.0000	.0000	.0000	.0608	.0000	.0000	.0000
38	.0000	.0106	.0000	.0000	.0000	.0000	.0000	.0000
40	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
Total	.0175	.0106	.0271	.0393	1.2722	.0655	.1939	.0584

Table 10: Disease condition of white fir trees within 60-foot radius of 28-inch *Fomes annosus*-infected stump based on culturing from stump disc and root samples.

Tree #	DBH (in)	Distance from Center	Tree Condition	Crown Symptoms	*Fomes annosus* Isolated
1	3.5	12'10"	Dead	...	Yes
2	0	19'9"	Live	No	No
3	0	19'11"	Live	No	Yes
4	0	20'10"	Recent Kill	...	Yes
5	10.5	23'2"	Dead	...	Yes
6	4.5	24'0"	Dead	...	Yes
7	3.0	24'8"	Live	Yes	Yes
8	2.0	25'2"	Dead	...	Yes
9	16.6	26'4"	Recent Kill	...	Yes
10	5.0	26'5"	Dead	...	Yes
11	4.7	26'8"	Live	No	No
12	4.0	26'9"	Dead	...	Yes
13	2.0	26'10"	Dead	...	Yes
14	17.3	27'2"	Recent Kill	...	Yes[1/]
15	14.3	31'0"	Live	No	No
16	4.0	32'5"	Live	No	No
17	1.0	33'8"	Live	No	Yes
18	4.5	34'0"	Live	No	Yes
19	0	35'0"	Live	No	No
20	2.0	36'0"	Live	No	Yes
21	0	36'2"	Live	No	No
22	16.0	36'5"	Live	No	No
23	9.5	38'8"	Live	No	No
24	1.8	41'11"	Live	No	No
25	4.2	47'11"	Live	No	No
26	2.5	48'9"	Live	No	Yes
27	1.8	48'10"	Live	No	No
28	1.8	51'5"	Live	No	No
29	0	53'0"	Dead	...	No
30	9.1	54.5"	Live	No	No
31	1.7	55'11"	Live	No	No
32	2.7	57'7"	Live	No	Yes[2/]
33	0	58'	Dead	...	No

1/ *Armillaria mellea* also isolated from this tree

2/ Has large wound and infection probably originated there rather than from roots

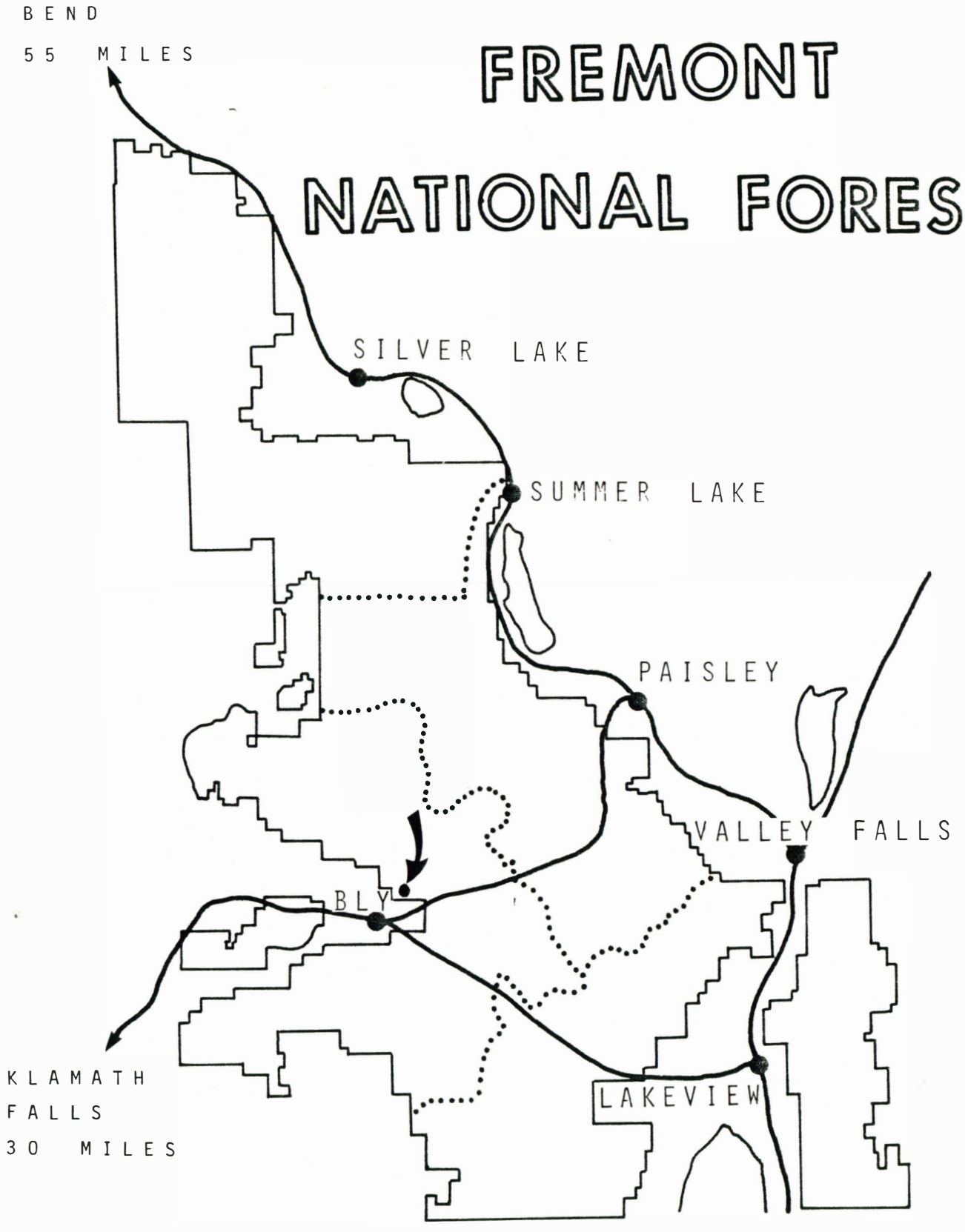


Figure 1: Location of Deming Timber Sale (arrow)

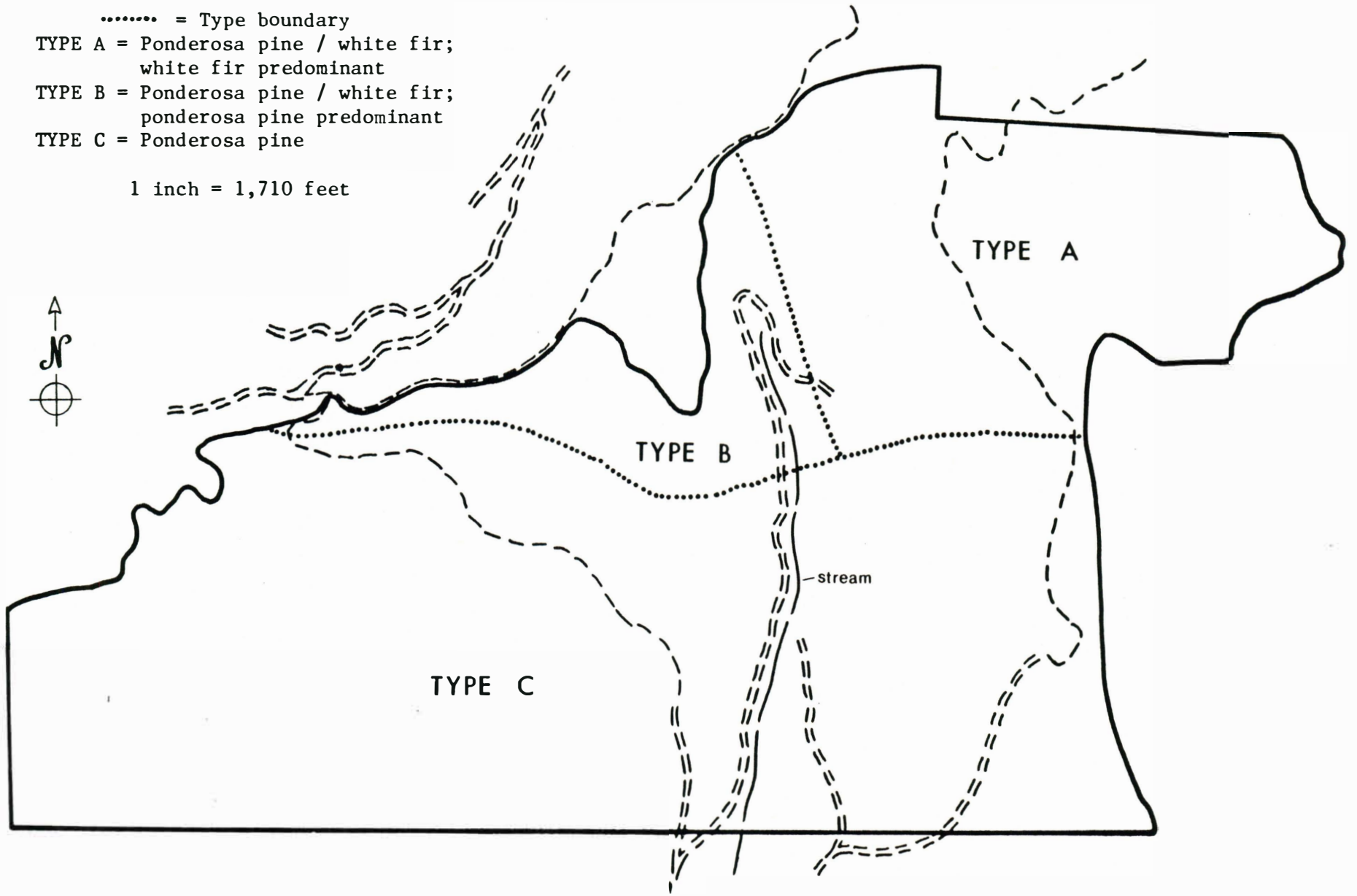

TIMBER TYPE MAP
••••••• = Type boundary
TYPE A = Ponderosa pine / white fir; white fir predominant
TYPE B = Ponderosa pine / white fir; ponderosa pine predominant
TYPE C = Ponderosa pine
1 inch = 1,710 feet
N
TYPE A
TYPE B
TYPE C
stream

Figure 2: Location of three stand types in Deming Timber Sale

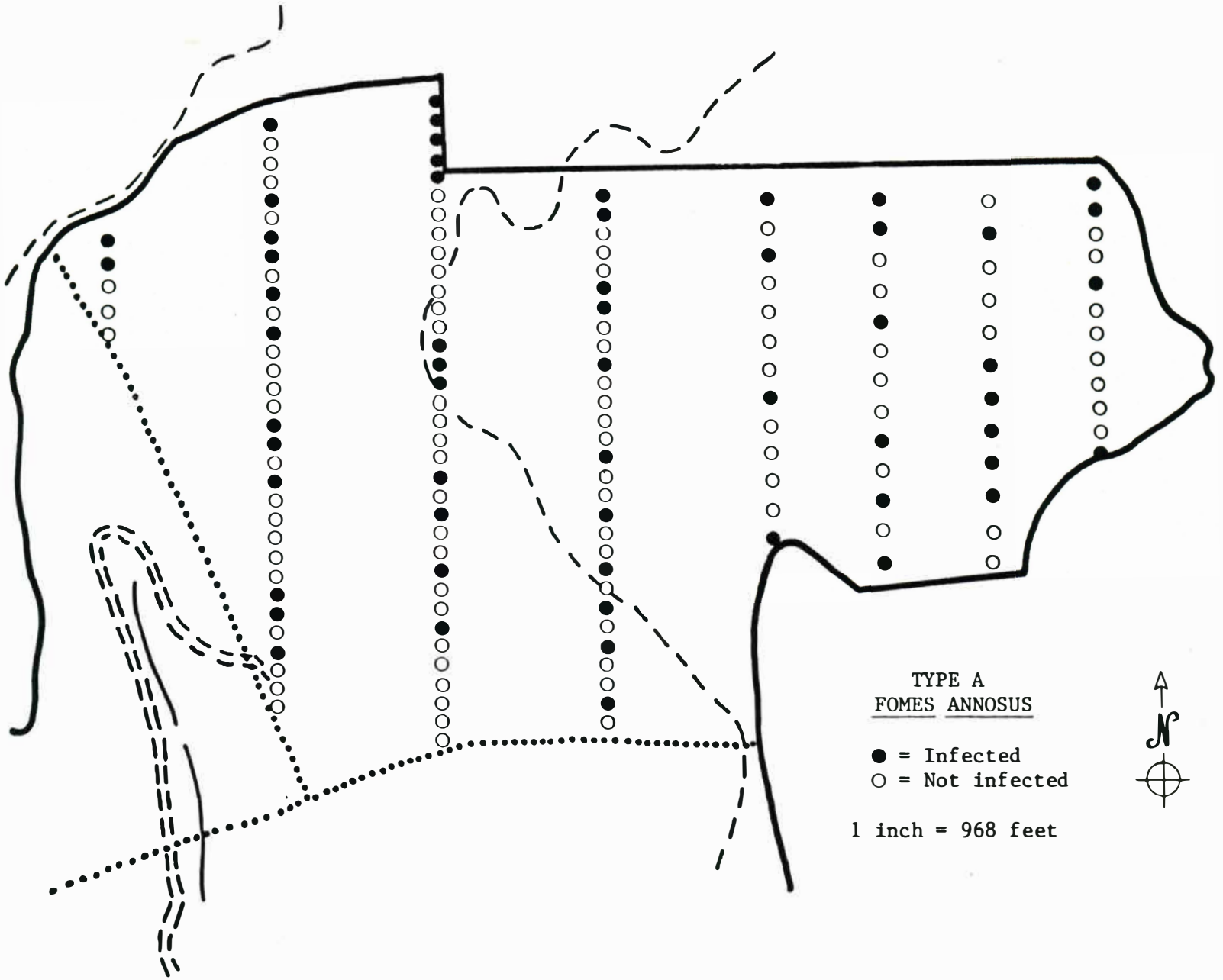
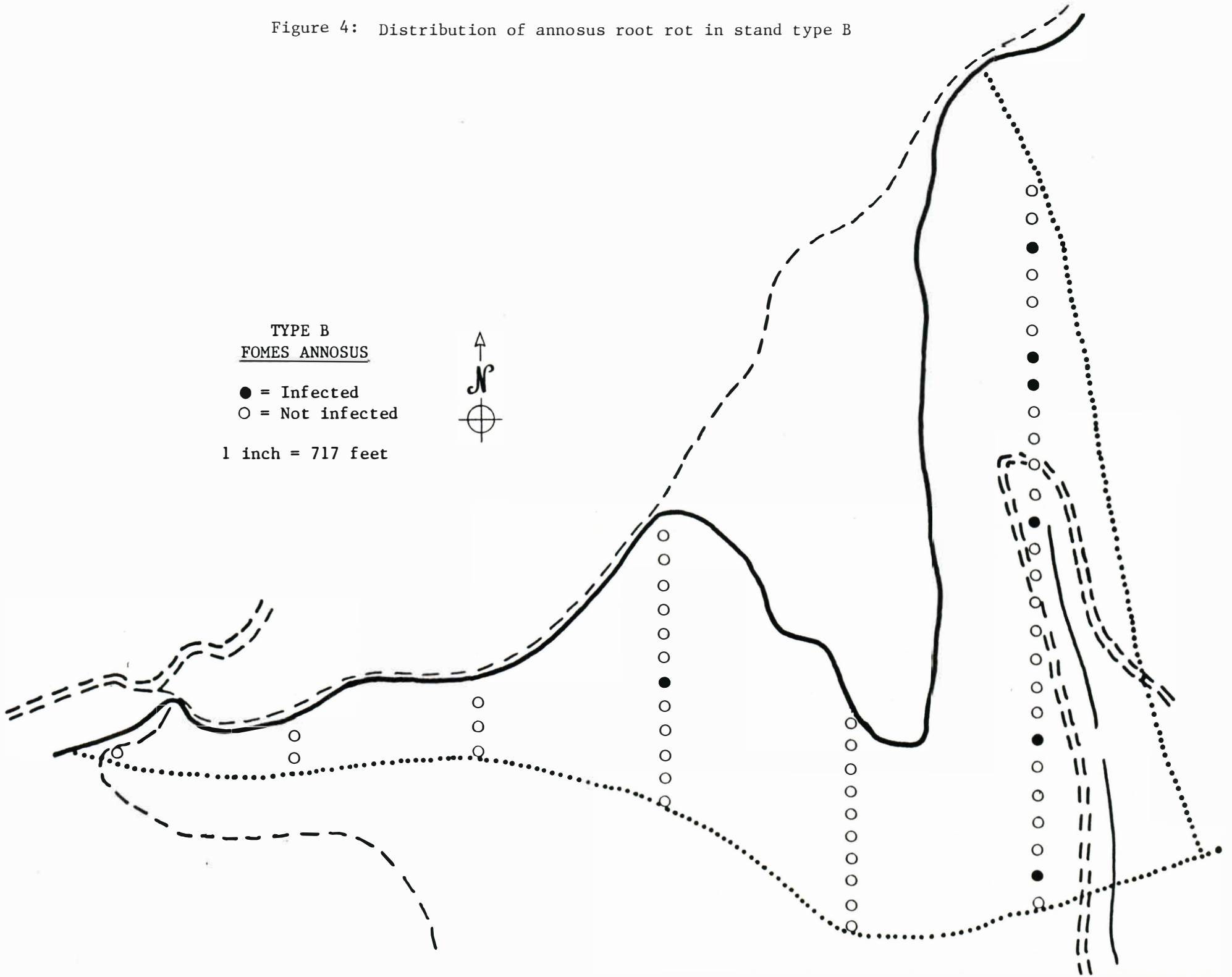


Figure 3: Distribution of annosus root rot in stand type A.

Figure 4: Distribution of annosus root rot in stand type B



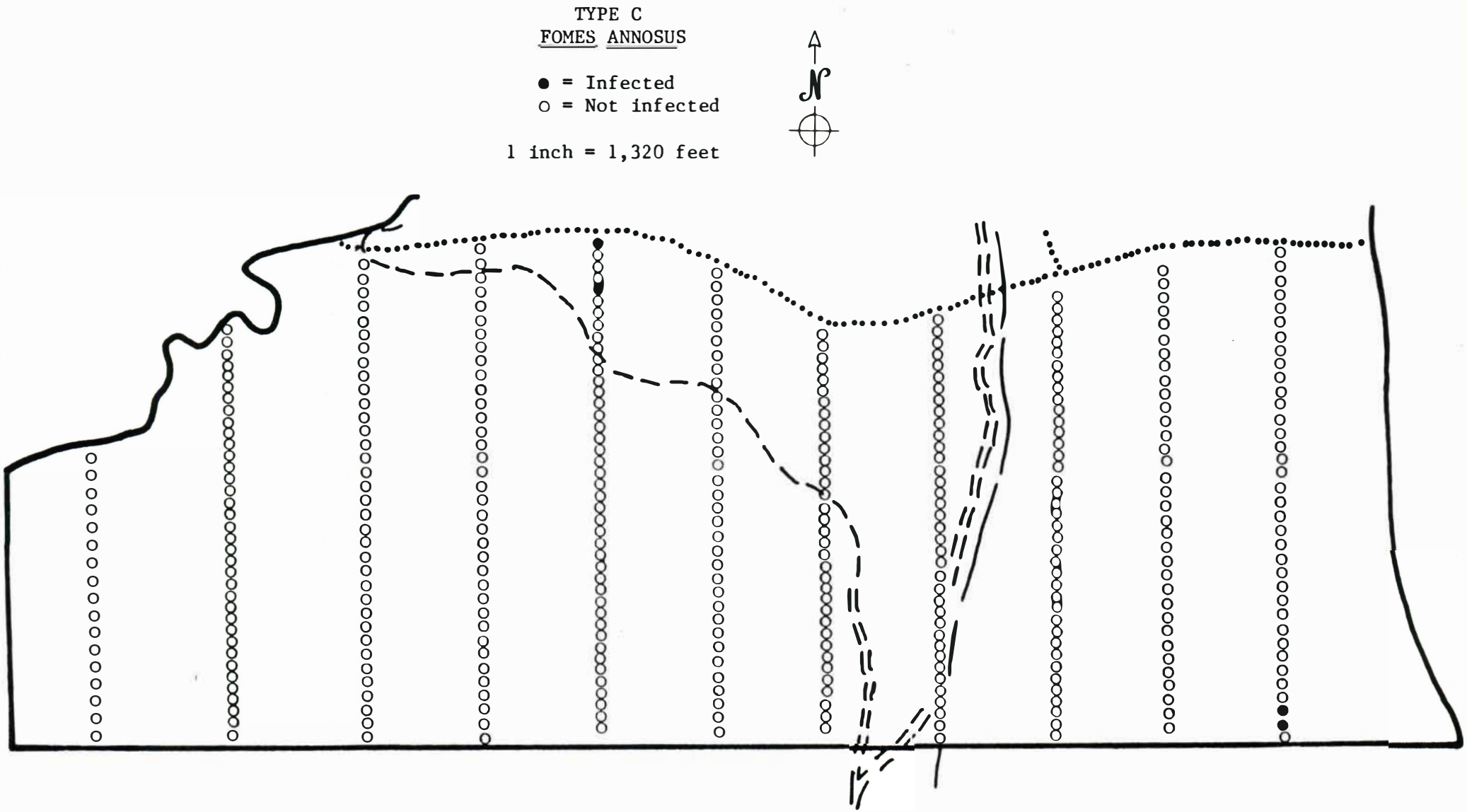


Figure 5: Distribution of annosus root rot in stand type C

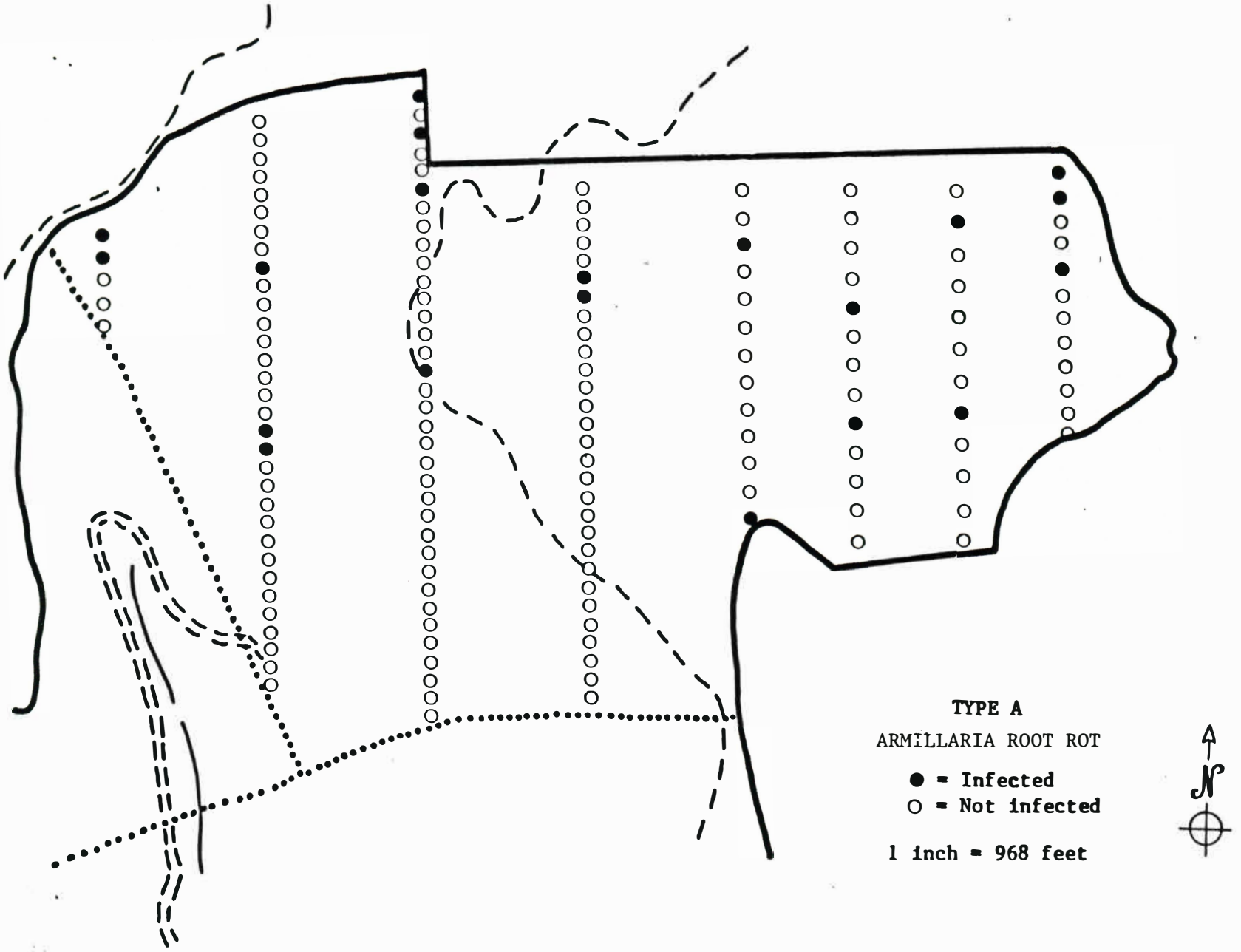


Figure 6: Distribution of Armillaria root rot in stand type A

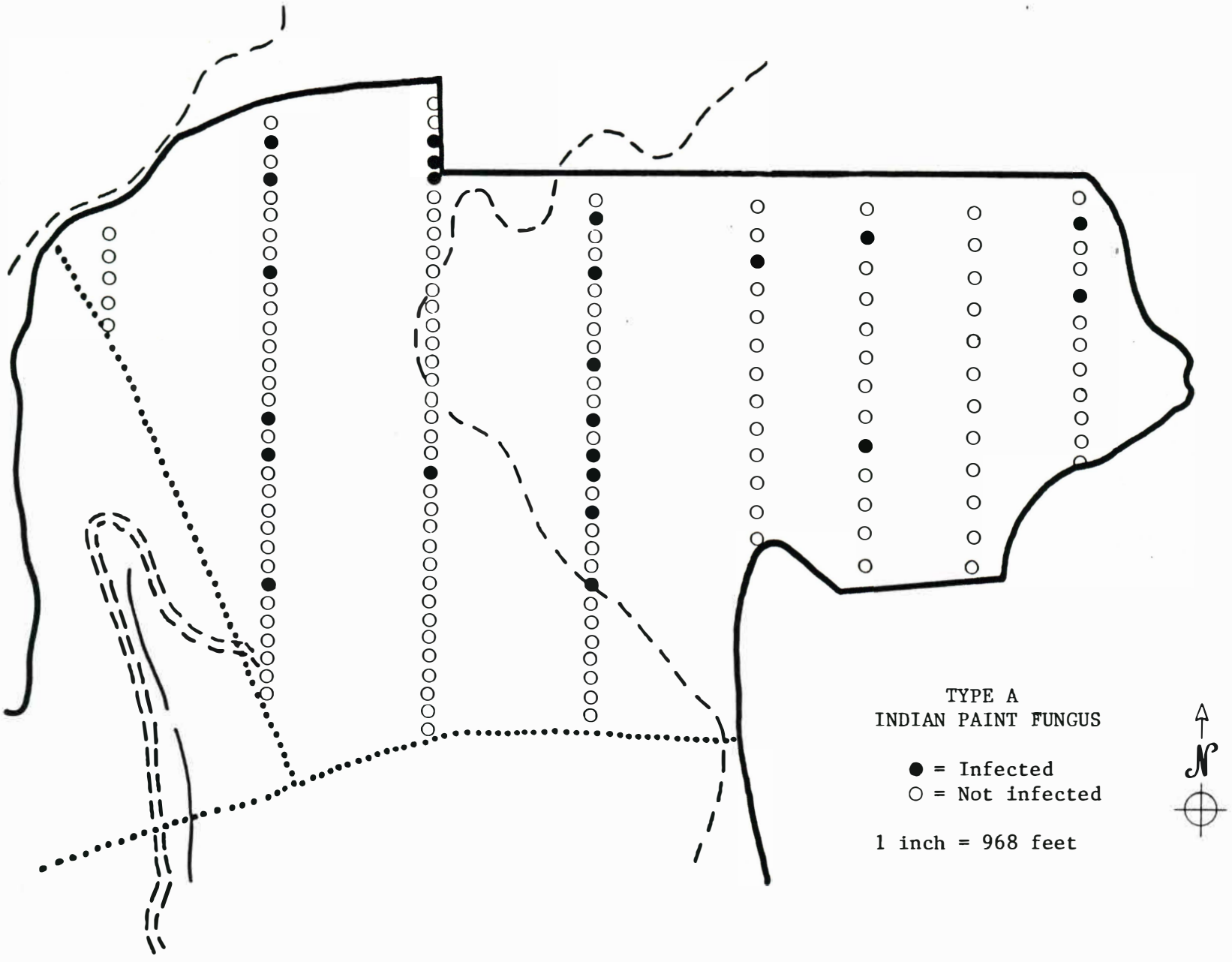
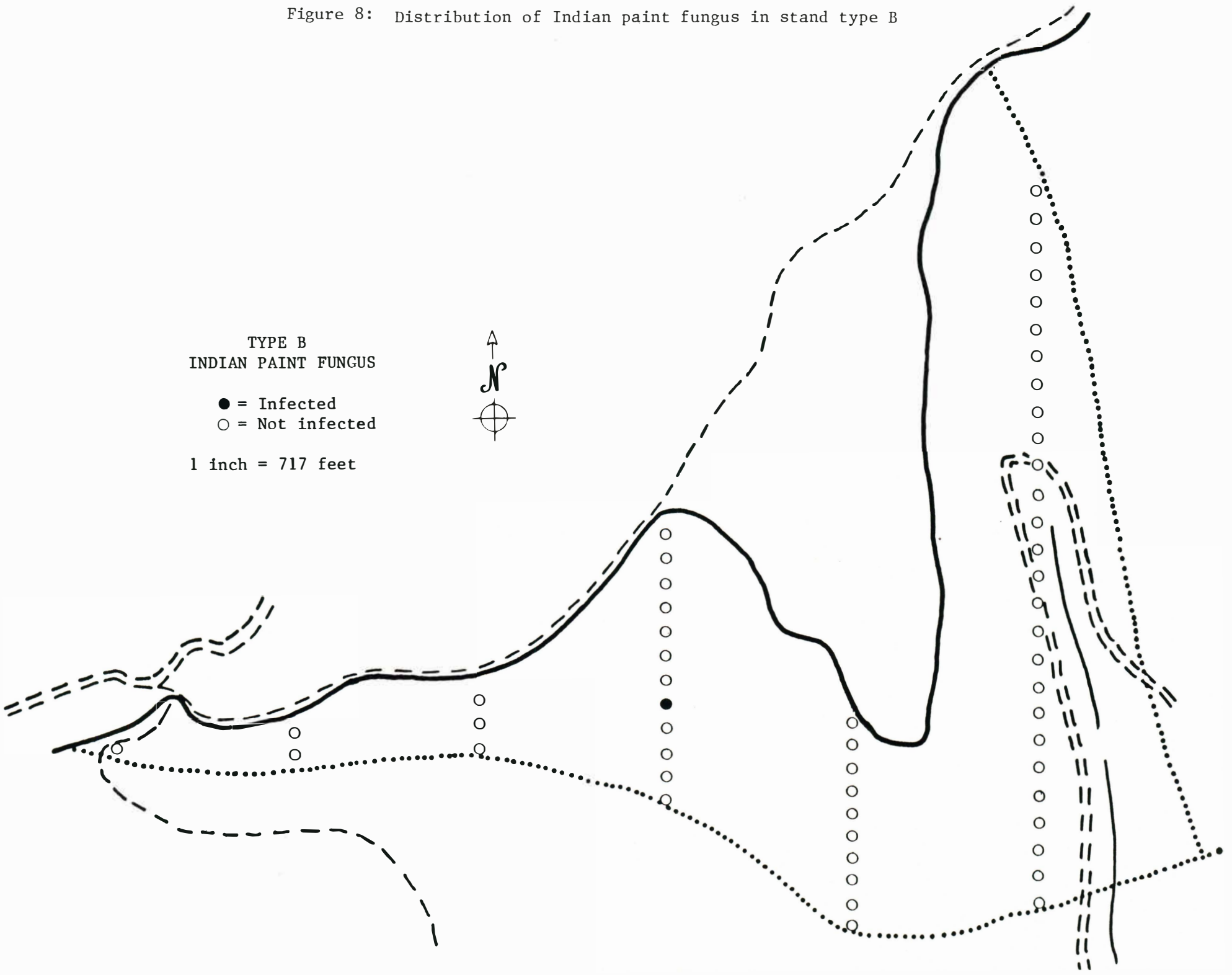


Figure 7: Distribution of Indian paint fungus in stand type A

Figure 8: Distribution of Indian paint fungus in stand type B



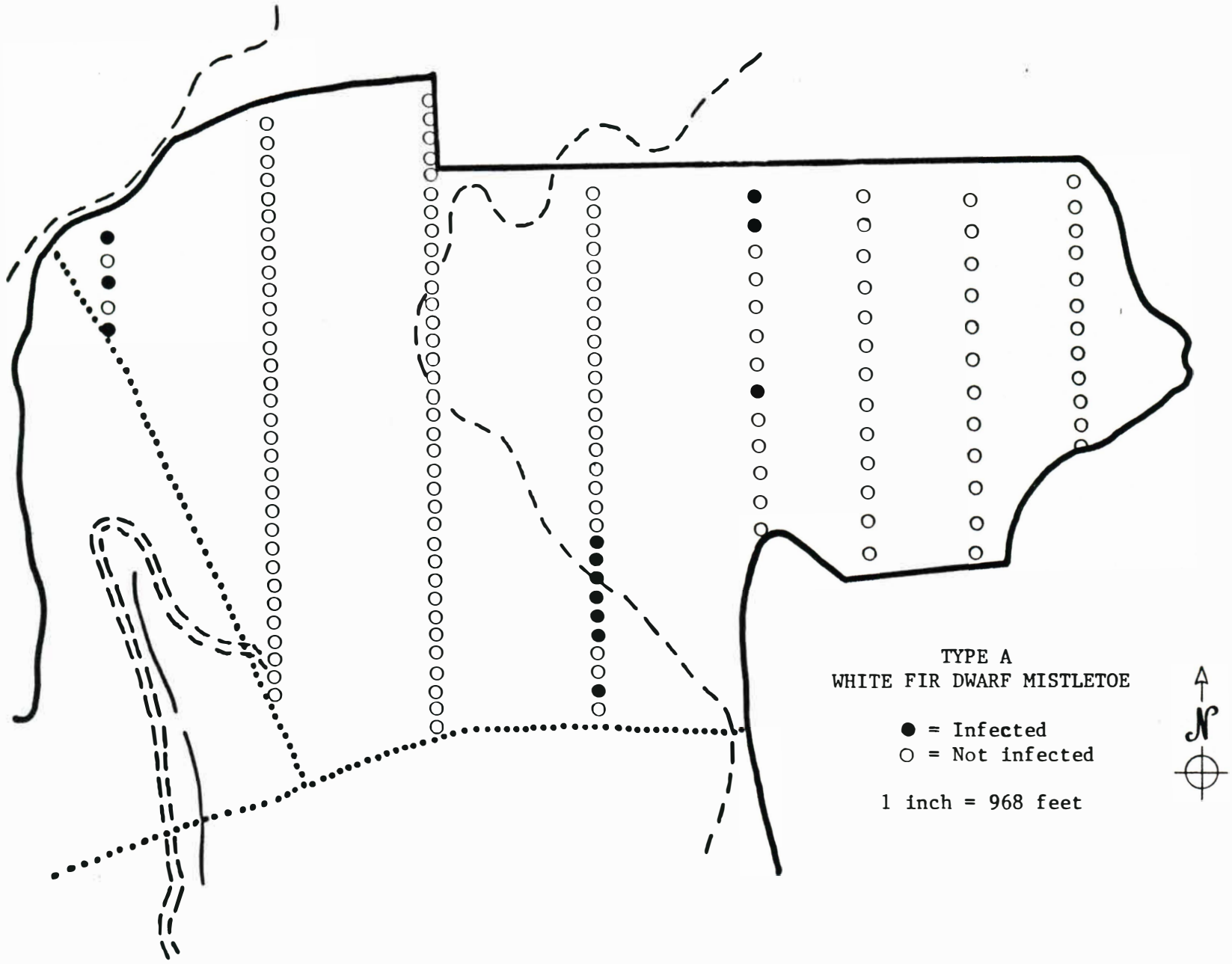


Figure 9: Distribution of white fir dwarf mistletoe in stand type A

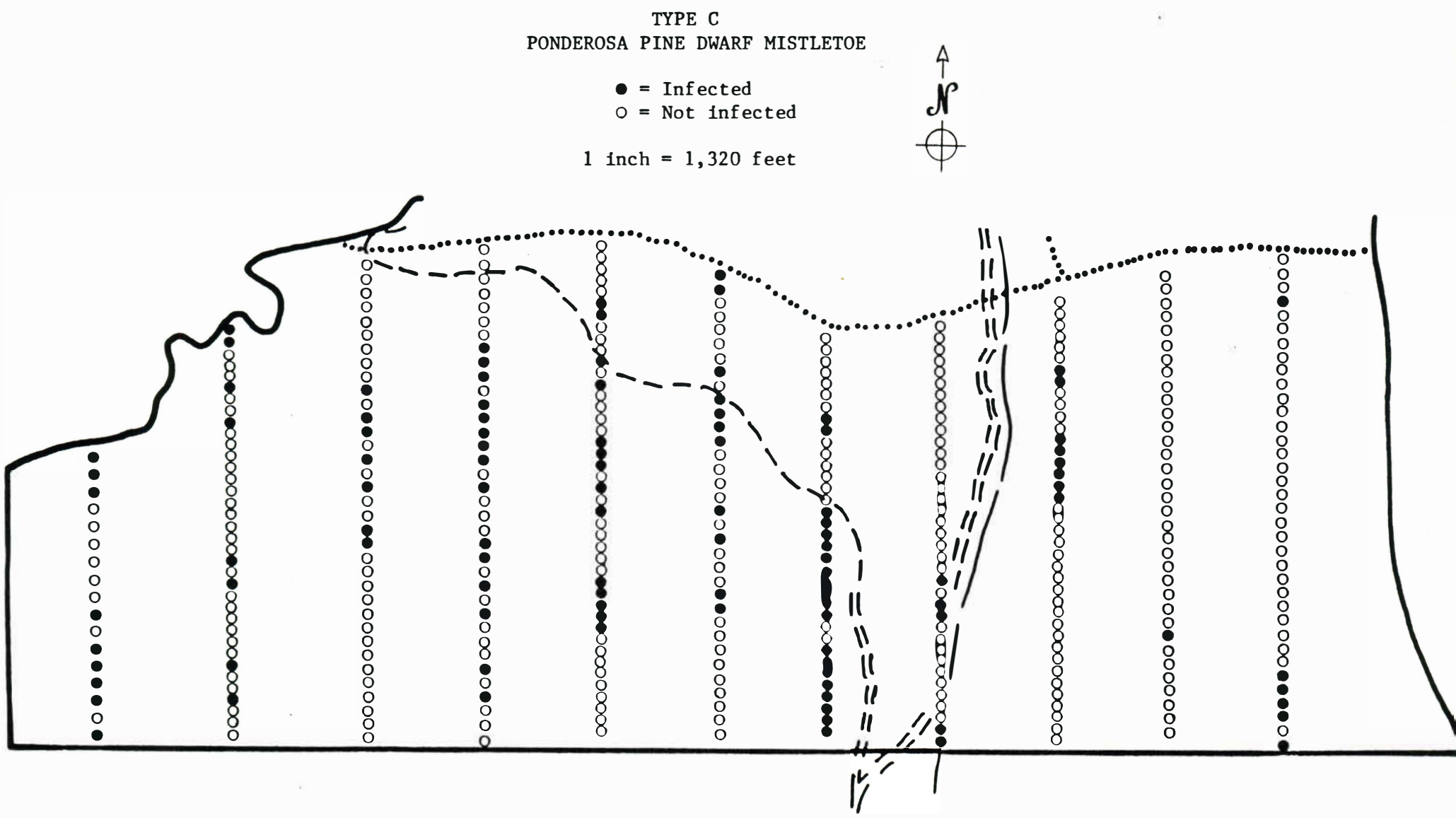


Figure 10: Distribution of ponderosa pine dwarf mistletoe in stand type C

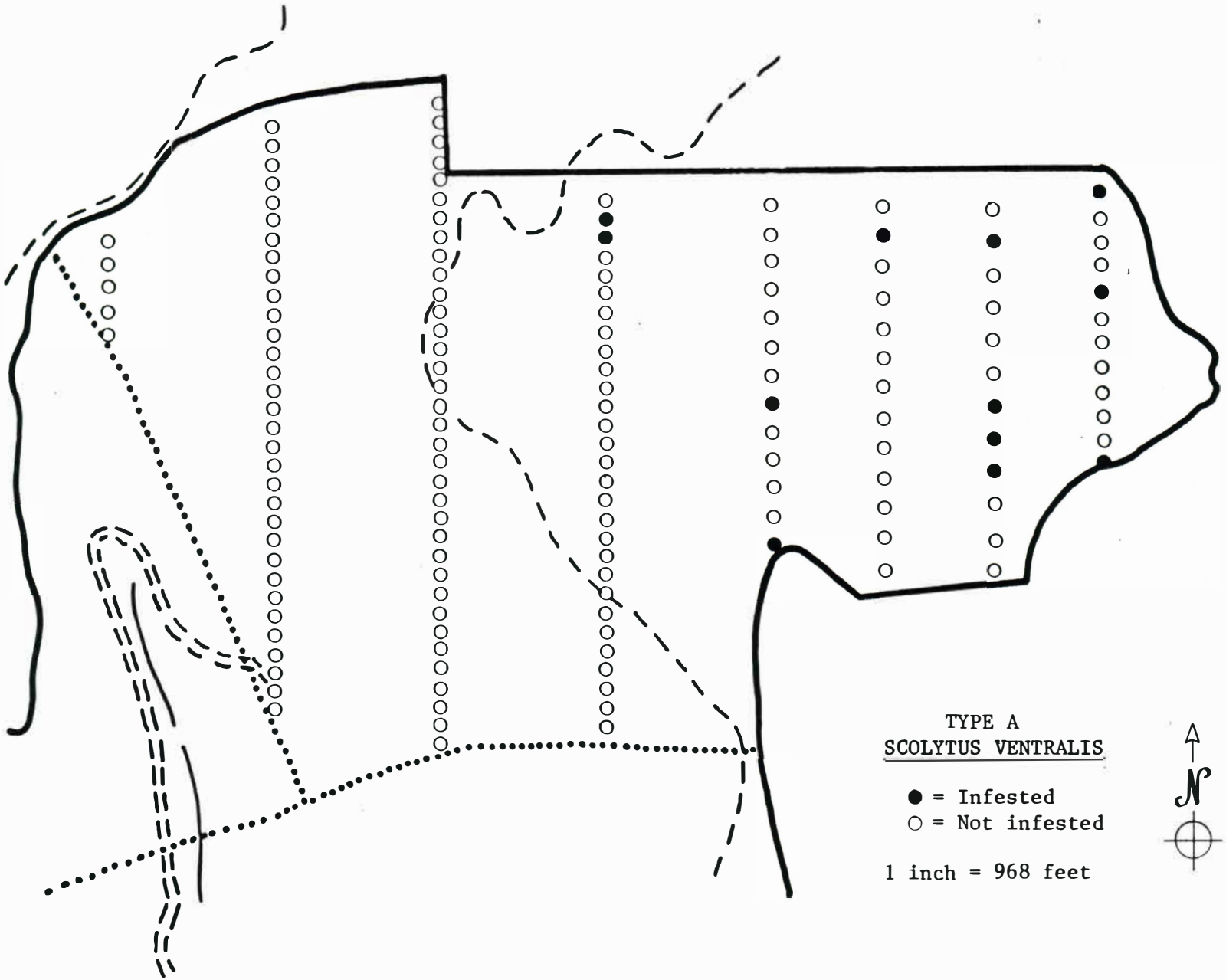


Figure 11: Distribution of Fir engraver beetle in stand type A

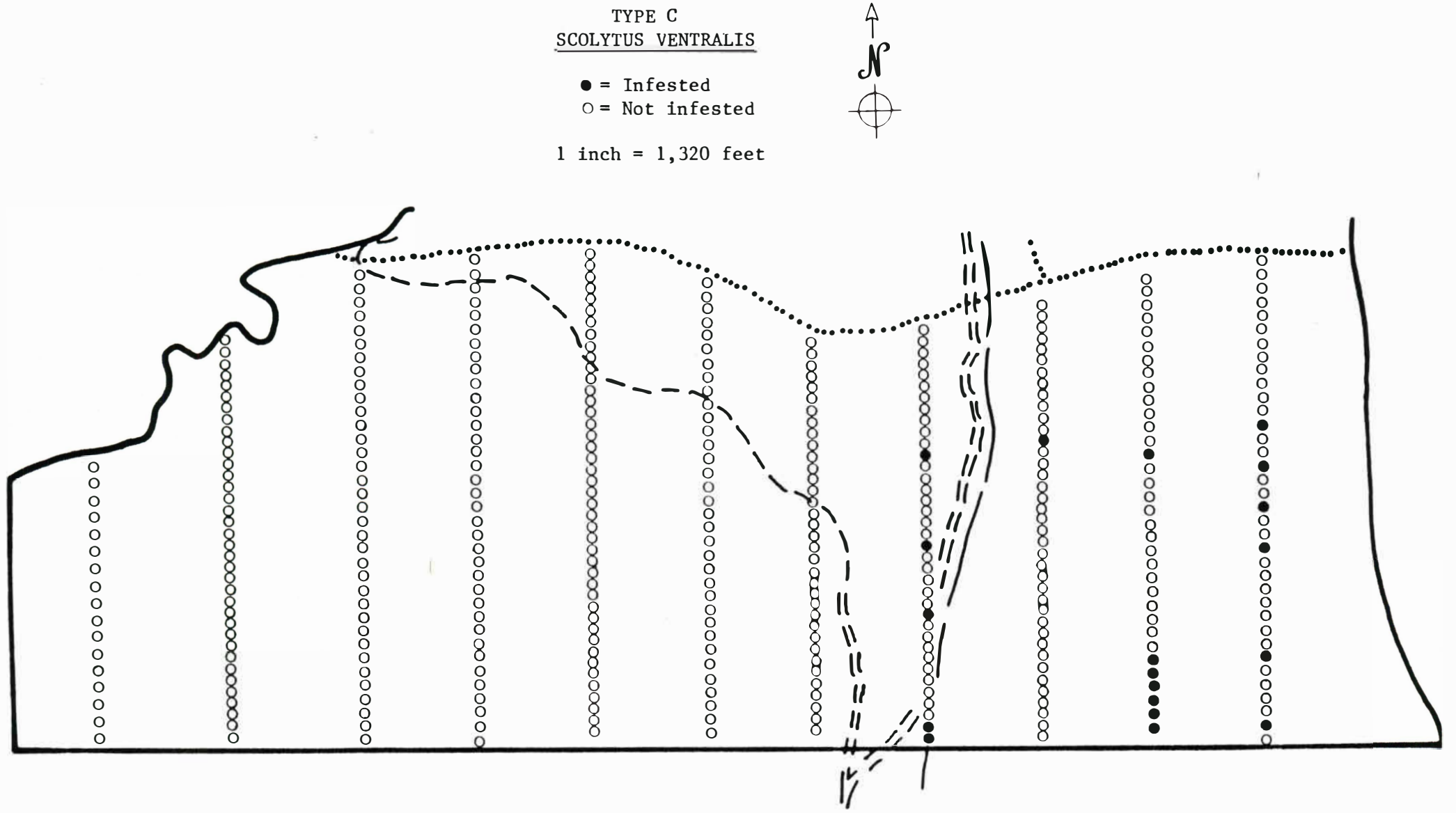


Figure 12: Distribution of Fir engraver beetle in stand type C

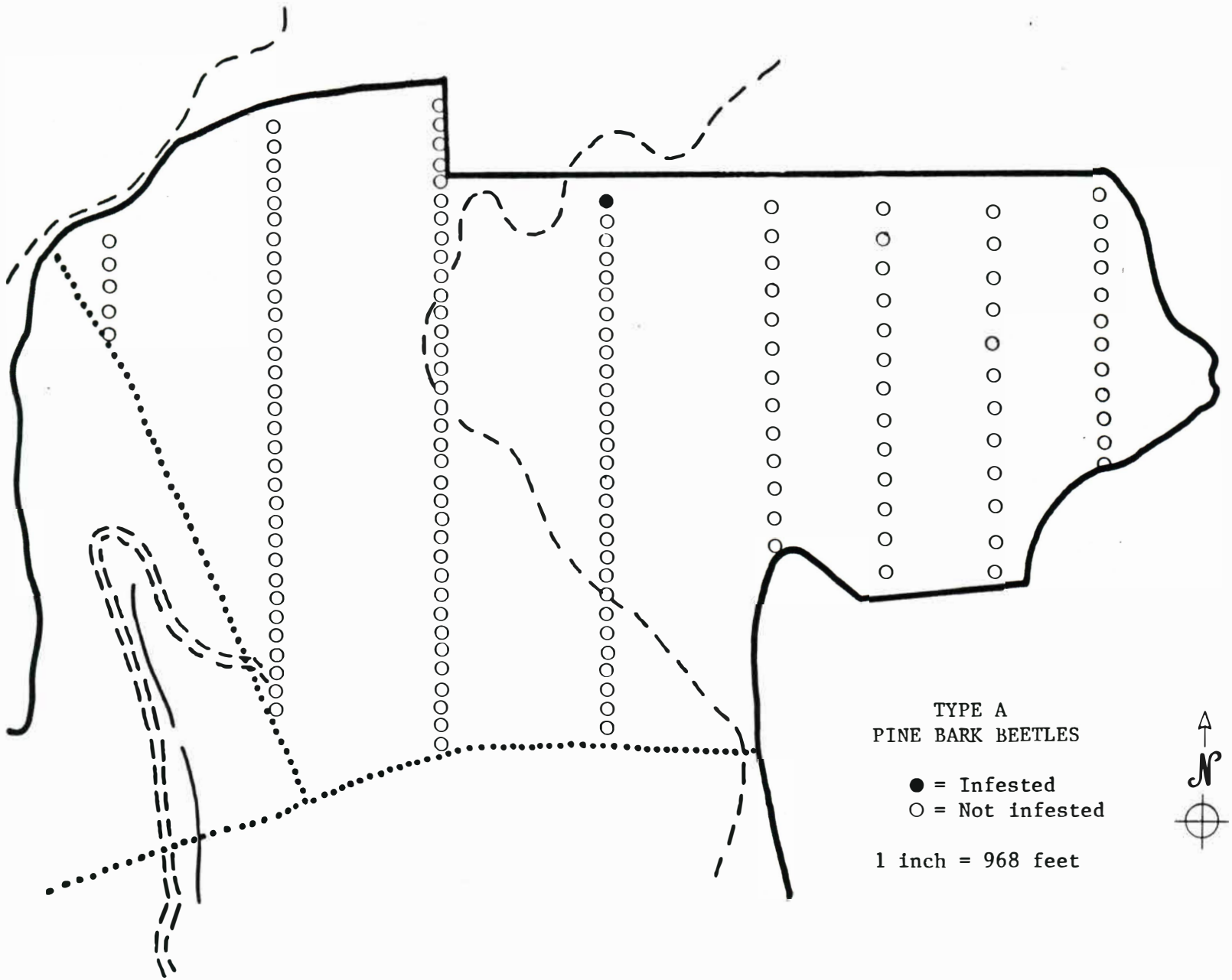
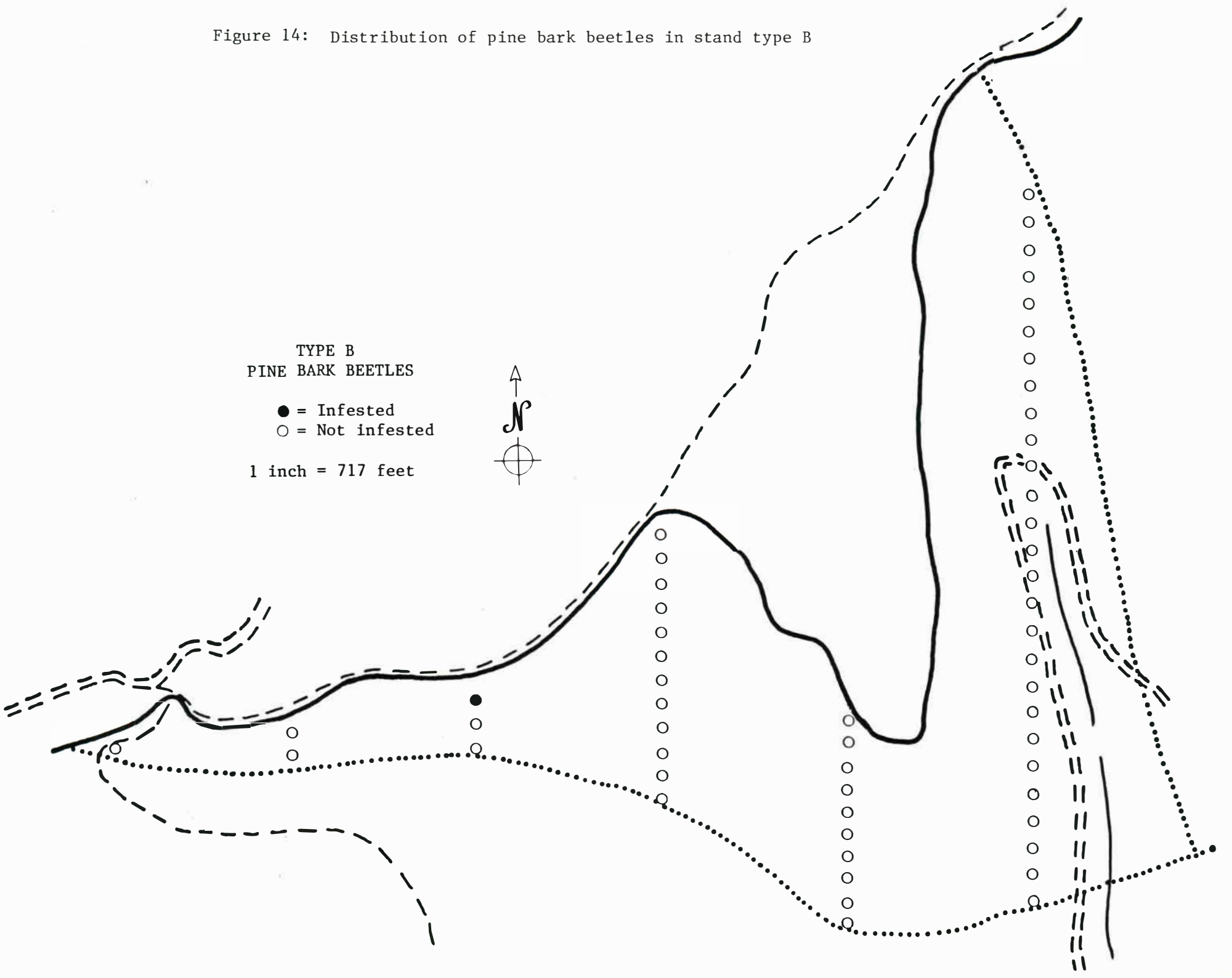


Figure 13: Distribution of pine bark beetles in stand type A

Figure 14: Distribution of pine bark beetles in stand type B



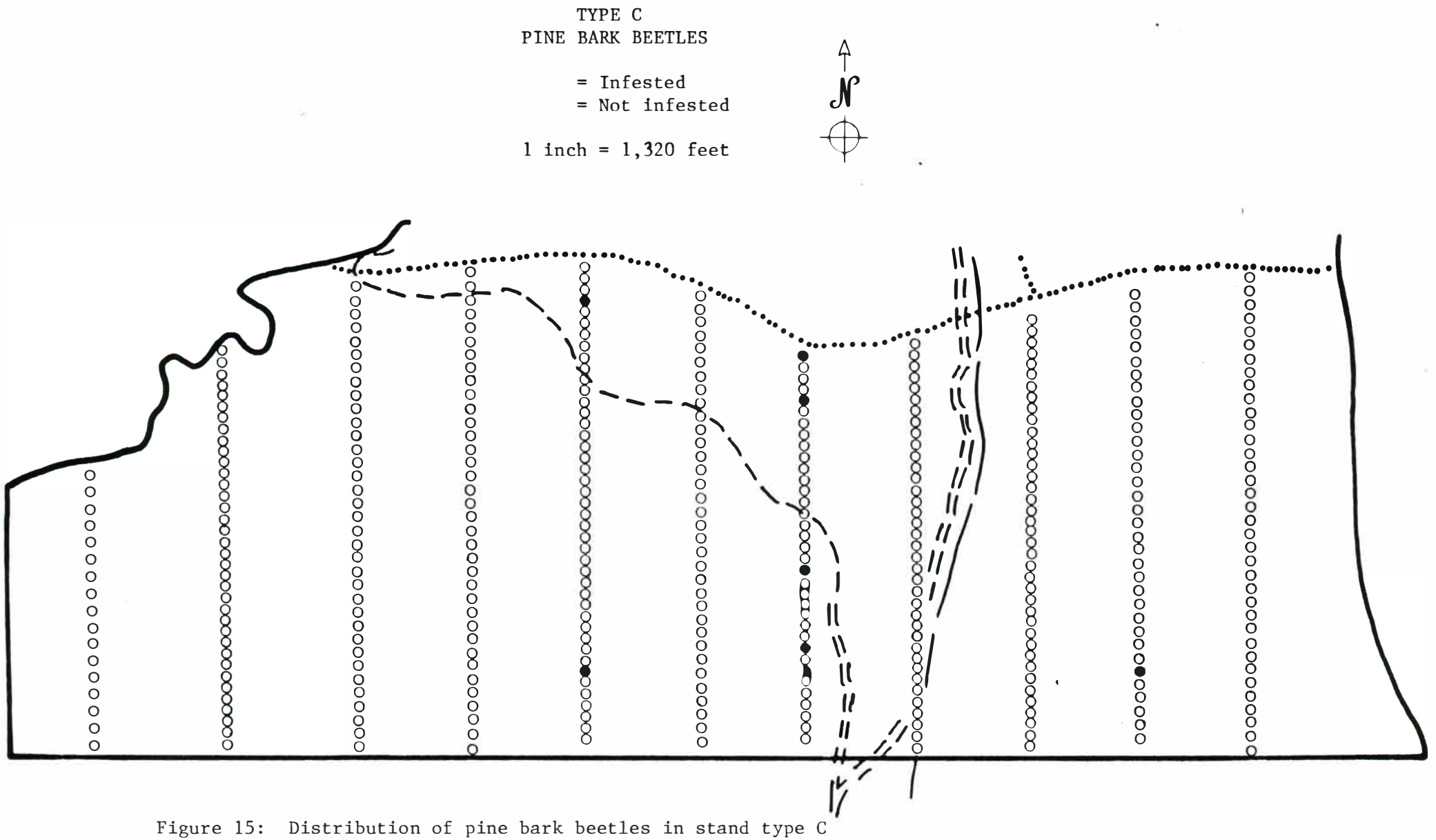


Figure 15: Distribution of pine bark beetles in stand type C

Fig. 16: Fruiting bodies of Fomes annosus in old, infected white fir stump.

Fig. 17: White fir mortality caused by annosus root rot.

Fig. 18: Annosus root rot infection center in white fir, Deming Sale Area

Fig. 19: Cross section of young white fir with extensive annosus root rot. Though heavily infected, this tree exhibited no foliage symptoms.

Fig. 20: Ponderosa pine dwarf mistletoe plant.

Fig. 21: Understory ponderosa pine ~~dwarf mistletoe plant~~.
severely infected by dwarf mistletoe